CLAIMS

We claim:

1. A spray head comprising:

a plurality of fluidic oscillators, each oscillator having a body member with top, bottom, side, front and rear outer surfaces, each oscillator having a fluidic circuit embedded in said top surface, said circuit forming a path in which a fluid may flow through said oscillator, each said fluidic circuit having a fluid inlet, a power nozzle, an interaction chamber and an outlet in said front surface from which a fluid may exit said oscillator,

wherein said oscillators being stacked one on top of the other,

wherein said body member being configured so that said oscillators stack such that the flow of fluid from adjoining oscillators in said stack have an angle of divergence between the centerlines of the planes defined by the flows from the outlets of said adjoining oscillators.

2. A spray head as recited in claim 1 further comprising a plurality of cover plates, wherein each said cover plate is configured, and is proximate the top surface of one of said fluidic oscillators, and is attached to said oscillator so as to provide a seal against the leakage of fluid from the top surface of said oscillator.

3. A spray head as recited in claim 2 further comprising a carrier assembly having a front and a rear surface and a cavity extending between said assembly surfaces, wherein said cavity configured so to receive and hold said stack of fluidic oscillators.

4. A spray head as recited in claim 3 further comprising a stopper unit that attaches to the rear surface of said assembly so as to provide a seal against the leakage of fluid from said assembly rear surface.

5. A spray head as recited in claim 1 wherein said angle of divergence is in the range of 2 – 5 degrees.

6. A spray head as recited in claim 2 wherein said angle of divergence is in the range of 2 – 5 degrees.

7. A spray head as recited in claim 3 wherein said angle of divergence is in the range of 2 – 5 degrees.

8. A method of forming a fluid spray whose droplets cover a specified surface area having a prescribed width and height, said area located at a prescribed distance in front of a spray head emitting said fluid spray, said method comprising the steps of:

stacking a plurality of fluidic oscillators one on top of the other, each oscillator having a body member with top, bottom, side, front and rear outer surfaces, each oscillator having a fluidic circuit embedded in said top surface, said circuit forming a path in which a fluid may flow through said oscillator, each said fluidic circuit having a fluid inlet, a power nozzle, an interaction chamber and an outlet having a prescribed fan angle in said front surface from which a fluid may exit said oscillator,

configuring said body members of said oscillator stack such that the flow of fluid from adjoining oscillators in said stack have a specified angle of divergence between the centerlines of the planes defined by the flows from the outlets of said adjoining oscillators,

selecting said fan angles of said oscillators so as to yield said prescribed spray width,

selecting said specified angle of divergence and the number of said fluidic oscillators in said stack so as to yield said prescribed spray height.

9. A method as recited in claim 8 further comprising the step of providing a plurality of cover plates, wherein each said cover plate is configured, and is proximate the top surface of one of said fluidic oscillators, and is attached to said oscillator so as to provide a seal against the leakage of fluid from the top surface of said oscillator.

10. A method as recited in claim 9 further comprising the step of providing a carrier assembly having a front and a rear surface and a cavity extending between said assembly surfaces, wherein said cavity configured so to receive and hold said stack of fluidic oscillators.

11. A method as recited in claim 8 wherein said angle of divergence is in the range of 2 – 5 degrees.

12. A method as recited in claim 9 wherein said angle of divergence is in the range of 2 – 5 degrees.

13. A method as recited in claim 10 wherein said angle of divergence is in the range of 2 – 5 degrees.

14. A method of providing a fluid spray at a flow rate in the range of approximately 1.2 – 1.9 gpm that yields massaging, tactile sensations, as the droplets of said spray impact upon the skin of one in the line of flight of said spray, which are comparable to those produced by non-fluidic, generated sprays operating in the range of approximately 2.0 - 2.5 gpm, said method comprising the steps of:

stacking a plurality of fluidic oscillators one on top of the other, each oscillator having a body member with top, bottom, side, front and rear outer surfaces, each oscillator having a fluidic circuit embedded in said top surface, said circuit forming a path in which a fluid may flow through said oscillator, each said fluidic circuit having a fluid inlet, a power nozzle, an interaction chamber and an outlet in said front surface from which a fluid may exit said oscillator, said circuit emitting an effective string of fluid droplets that are swept from side-to-side at a prescribed frequency which is dependent upon said circuit geometry,

configuring said body members of said oscillator stack such that the flow of fluid from adjoining oscillators in said stack have a specified angle of divergence between the centerlines of the planes defined by the flows from the outlets of said adjoining oscillators,

selecting said prescribed frequencies of said oscillators to be in the range between 10 cps and 60 cps.

15. A method as recited in claim 14 further comprising the step of providing a plurality of cover plates, wherein each said cover plate is configured, and is proximate the top surface of one of said fluidic oscillators, and is attached to said oscillator so as to provide a seal against the leakage of fluid from the top surface of said oscillators.

16. A method as recited in claim 15 further comprising the step of providing a carrier assembly having a front and a rear surface and a cavity extending between said assembly surfaces, wherein said cavity configured so to receive and hold said stack of fluidic oscillators.

17. A method as recited in claim 14 wherein said angle of divergence is in the range of 2 – 5 degrees.

18. A method as recited in claim 15 wherein said angle of divergence is in the range of 2 – 5 degrees.

19. A method as recited in claim 16 wherein said angle of divergence is in the range of 2 – 5 degrees.

20. A method of providing a fluid spray at a flow rate in the range of approximately 1.2 – 1.9 gpm that yields massaging, tactile sensations, as the droplets of said spray impact upon the skin of one in the line of flight of said spray, which are comparable to those produced by non-fluidic generated sprays operating in the range of approximately 2.0 - 2.5 gpm, said method comprising the steps of:

using a fluidic oscillator to generate said spray,

wherein said fluidic oscillator configured so as to provide a spray which exhibits an oscillation frequency in the range of 10 - 60 cps.

21. A method of providing a fluid spray that yields massaging, tactile sensations, as the droplets of said spray impact upon the skin of one in the line of flight of said spray, said method comprising the steps of:

using a fluidic oscillator to generate said spray,

wherein said fluidic oscillator configured so as to provide a spray which exhibits an oscillation frequency in the range of 10 - 60 cps.

22. A method of providing a fluid spray at a specified flow rate that feels, as the droplets of said spray impact upon the skin of a bather in the line of flight of said spray, to a bather using said spray that said spray is being delivered at a higher flow rate than said specified flow rate at which said spray is being operated, said method comprising the steps of:

using a fluidic oscillator to generate said spray,

wherein said fluidic oscillator configured so as to provide a spray which exhibits an oscillation frequency of greater than 60 cps.

23. A method of providing a multi-functional spray head, said method comprising the steps of:

stacking a plurality of fluidic oscillators one on top of the other, each oscillator having a body member with top, bottom, side, front and rear outer surfaces, each oscillator having a fluidic circuit embedded in said top surface, said circuit forming a path in which a fluid may flow through said oscillator, each said fluidic circuit having a fluid inlet, a power nozzle, an interaction chamber and an outlet having a prescribed fan angle in said front surface from which a fluid may exit said oscillator,

configuring said body members of said oscillator stack such that the flow of fluid from adjoining oscillators in said stack have a specified angle of divergence between the centerlines of the planes defined by the flows from the outlets of said adjoining oscillators,

surrounding said stack of fluidic oscillators with a plurality of orifices that emit fluid sprays formed by other than the use of fluidic oscillators.

24. A spray head comprising:

a plurality of fluidic oscillators, each oscillator having a body member with top, bottom, side, front and rear outer surfaces, each oscillator having a fluidic circuit embedded in said top surface, said circuit forming a path in which a fluid may flow through said oscillator, each said fluidic circuit having a fluid inlet, a power nozzle, an interaction chamber and an outlet in said front surface from which a fluid may exit said oscillator,

a carrier assembly having a front and a rear surface and a plurality of slots which are aligned one above the other with each slot extending between said assembly surfaces, wherein each of said slots configured so to receive and hold one of said fluidic oscillators, wherein each of said slots having a centerline,

wherein said carrier assembly being further configured so that said slot centerlines align such that the flow of fluid from adjoining oscillators in said slots have an angle of divergence between the centerlines of the planes defined by the flows from the outlets of said adjoining oscillators.

25. A spray head as recited in claim 24 wherein said angle of divergence is in the range of 2 – 5 degrees.

26. A method of forming a fluid spray comprising the steps of:

assembling a plurality of fluidic oscillators, each oscillator having a body member with top, bottom, side, front and rear outer surfaces, each oscillator having a fluidic circuit embedded in said top surface, said circuit forming a path in which a fluid may flow through said oscillator, each said fluidic circuit having a fluid inlet, a power nozzle, an interaction chamber and an outlet in said front surface from which a fluid may exit said oscillator,

fabricating a carrier assembly having a front and a rear surface and a plurality of slots which are aligned one above the other with each slot extending between said assembly surfaces, wherein each of said slots configured so to receive and hold one of said fluidic oscillators, wherein each of said slots having a centerline,

wherein said carrier assembly being further configured so that said slot centerlines align such that the flow of fluid from adjoining oscillators in said slots have an angle of divergence between the centerlines of the planes defined by the flows from the outlets of said adjoining oscillators.

27. A method as recited in claim 26 wherein said angle of divergence is in the range of 2 – 5 degrees.